CLAIMS

1. Electrochemical device, in particular an electrically controllable system having variable optical and/or energy properties, including at least one carrier substrate provided with a stack of functional layers comprising at least one electrically conducting layer A based on metal oxide(s) and at least one electrochemically active layer F, **characterized in that** said layer A is part of a multicomponent electrode E combining with the layer A at least one higher-conductivity material B and/or at least one network C of conducting wires or of conducting strips.

2. Device according to Claim 1, **characterized in that** the material B is in the form of at least one layer combined with the layer A and in electrical contact therewith.

3. Device according to Claim 1, **characterized in that** the material B is incorporated in the layer A, in particular in the form of fibres or particles.

4. Device according to one of the preceding claims, **characterized in that** the layer(s) A is/are based on doped metal oxides chosen from at least one of the following doped oxides: doped tin oxide, in particular fluorine- or antimony-doped, doped zinc oxide, in particular aluminium-, tin- or fluorine-doped, and doped indium oxide, in particular tin-doped (ITO).

5. Device according to one of the preceding claims, **characterized in that** the material B is essentially metallic, in particular based on metals or on their alloys, for example Ag, Au, Cu, Al, or on alloys of Ag with another metal, in particular nickel or titanium.

6. Device according to one of the preceding claims, **characterized in that** said multicomponent electrode E is essentially transparent in the visible region.

7. Device according to one of the preceding claims, **characterized in that** said network C includes a

plurality of conducting strips, in particular essentially parallel each to the other and obtained by screen printing using a paste-like suspension of silver-type metal and a low-melting-point frit in an organic binder.

8. Device according to Claim 7, **characterized in that** the network C is screen-printed onto the glass-type carrier substrate, then covered with at least one electrically conducting layer A in order to form an electrode E, or is laid down on the electrically conducting layer A covering the carrier substrate.

9. Device according to one of Claims 1 to 5, **characterized in that** the network C includes a plurality of conducting wires in the form of essentially metallic wires surface-laid on a sheet based on thermoplastic polymer.

10. Device according to one of Claims 1 to 5, **characterized in that** the network C is based on a fabric, a net or a metallic nonwoven, in particular a network obtained using metallic wires of diameter between 10 and 100 µm, and is preferably a network surface-laid on a sheet based on thermoplastic polymer.

11. Device according to one of Claims 1 to 5, **characterized in that** the network C is obtained by etching or perforating a metallic layer or a metallic sheet.

12. Device according to one of the preceding claims, **characterized in that** the multicomponent electrode E comprises at least one layer A and at least one layer B in electrical contact, at least one of these layers optionally being in contact with at least one layer D of dielectric material, and all of the layers A, B and D preferably forming a stack of layers with interference interaction.

13. Device according to Claim 12, **characterized in that** the layer(s) D have an optical function and/or a function of anchoring the other layers B to the carrier substrate and/or a function as a barrier to the migration of alkaline species coming from the glass, in

particular in the form of oxide, oxycarbide or oxynitride of a metal or of silicon, or silicon nitride.

14. Device according to one of the preceding claims, **characterized in that** the multicomponent electrode(s) E comprise(s) the sequence ITO/Ag/ITO or Ag/ITO with optional interposition of thin layers of partially oxidized metal at the Ag/ITO interface.

15. Device according to one of the preceding claims, **characterized in that** the multicomponent electrode(s) E is/are provided with current leads, in particular in the form of metal braids or shims.

16. Device according to one of the preceding claims, **characterized in that** it is an electrochromic system, in particular an "all-solid" or "all-polymer" electrochromic system, with at least one carrier substrate and a stack of functional layers comprising at least, in succession, a first electrically conducting layer, an electrochemically active layer liable to reversible insertion of ions, such as H^+, Li^+ or OH^-, of anodic-colouring or, respectively, cathodic-colouring electrochromic material type, a layer of electrolyte, a second electrochemically active layer liable to reversible insertion of ions, such as H^+, Li^+ or OH^-, of cathodic-colouring or, respectively, anodic-colouring electrochromic material type, and a second electrically conducting layer, with at least one of the two electrically conducting layers in the form of a layer A based on metal oxide(s) and being part of a multi-component electrode E.

17. Device according to one of Claims 1 to 15, **characterized in that** it is a viologenic system with at least one carrier substrate and a stack of functional layers comprising at least, in succession, a first electrically conducting layer, a film having viologenic properties in the form of a polymer, of a gel or of a suspension in a liquid medium, and a second electrically conducting layer, with at least one of the two electrically conducting layers being of type A

based on metal oxide(s) and being part of a multi-component electrode E.

18. Device according to one of the preceding claims, **characterized in that** the stack of functional layers is arranged between two substrates, each of which may be rigid, of glass type or rigid polymer, such as polycarbonate or PMMA, or semi-rigid or flexible of PET type, all of these being preferably transparent or absorbent or otherwise.

19. Glazing **characterized in that** it incorporates the device according to one of the preceding claims, said device using as carrier substrate at least one of the rigid constituent substrates of the glazing and/or at least one flexible substrate combined by lamination with one of the rigid constituent substrates of said glazing.

20. Use of the device according to one of Claims 1 to 18 or of the glazing according to Claim 19 for making glazing for buildings, in particular exterior glazing or internal partition glazing or door glazing or roof windows, glazing equipping internal partitions or windows or roof windows in means of transport of the type comprising trains, aircraft, cars and boats, glazing for display screens of the type comprising computer or television screens, or touch screens, or for making spectacles or camera lenses or protection for solar panels.

21. Use of the device according to one of Claims 1 to 18 for making electrochemical energy-storing devices of battery or fuel-cell type.

PATENT

ELECTROCHEMICAL DEVICE OF ELECTRICALLY CONTROLLABLE SYSTEM TYPE HAVING VARIABLE OPTICAL AND/OR ENERGY PROPERTIES

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The subject of the invention is an electrochemical device, in particular an electrically controllable system having variable optical and/or energy properties, including at least one carrier substrate provided with a stack of functional layers comprising at least one electrically conducting layer A based on metal oxide(s) and at least one electrochemically active layer F. Said layer A is part of a multicomponent electrode E combining with the layer A at least one higher-conductivity material B and/or at least one network C of conducting wires or conducting strips.

Another subject of the invention is the applications of the device, in particular in glazing.